

## TIME BUDGET AND ACTIVITIES PATTERN OF CAPPED LANGURS *TRACHYPITHECUS PILEATUS* IN PAKKE WILDLIFE SANCTUARY, ARUNACHAL PRADESH, INDIA

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Time allocation for activities in langurs are endorsed by environmental and habitat conditions. We studied time allocation for various activities by Capped Langurs *Trachypithecus pileatus* on daily, monthly, seasonal, and annual basis over one-year period in the Pakke Wildlife Sanctuary, Arunachal Pradesh, India. 90% of annual time budget was spent feeding and resting; the time devoted to resting was significantly higher ( $P < 0.01$ ) than that devoted to feeding. Seasonal variations ( $P < 0.05$ ) were found in both feeding and resting times; the maximum time devoted to feeding was 39% in the winter; the maximum time devoted to resting was 59% in the monsoon. The amount of time devoted to major activities in different months was significantly ( $P < 0.001$ ) different. Feeding time was maximum (43%) in December and minimum (33%) in May; the variations were found to be significant ( $P < 0.01$ ). The only month with maximum time (43%) devoted to feeding was in December, maximum resting (63%) time was in August, and maximum travelling (8%) time was in February in comparison to other months and remaining time was distributed to other activities. The diurnal activity budget of capped langurs indicated a bimodal feeding pattern. The evening feeding regime was significantly higher ( $P < 0.05$ ) than the morning one. It was 42% in morning hours and 51% in the evening.

**Key words:** Time budgets, daily activity patterns, capped langurs, Pakke Wildlife Sanctuary

### INTRODUCTION

The Colobines are a diverse group of primates of different body size, which occur in a wide range of habitats and behave differently in order to maintain time-energy balances (Clutton-Brock 1974; Marsh 1978, 1981; Li 1992; Li and Rogers 2004; Malik 1986; Kurup and Kumar 1993; Watanuki and Nakayama 1993; Menon and Poirier 1996). The Capped Langur *Trachypithecus pileatus* is an endangered colobine species, indigenous to the north-eastern part of India (Choudhury 1989; Srivastava 1999). Its global distribution is restricted to Bangladesh, north-western Myanmar, Bhutan and southern China (Roonwal and Mohnot 1977; Zhang *et al.* 1981; Khan and Ahsan 1986; Stanford 1991; Ahsan 1994; Srivastava 1999).

The manner in which an animal allocates its time to various essential activities provides a useful window to its overall ecological strategy. In particular, the optimum utilization of resources in the habitat is paramount for an animal's survival and reproduction. Day length is a limiting factor in natural populations and influences all aspects of behaviour in social animals, especially anthropoids – day active primates, which have to meet and maintain their physiological and social needs (Altmann 1980; Dunbar 1988, 1992; Janson 1992). This constraint exerts pressure on the animal for budgeting its available time in the most efficient manner (Pyke *et al.* 1977; Altmann 1980). The Colobines living in a diverse array of habitats, the biology and behaviour of

this monkey species has not been studied except by Stanford (1991) in Bangladesh, and a short study by Gupta (1994) and Alfred *et al.* (1998) in Tripura, India. Here we present data from a one year study of daily activities of Capped langurs in Pakke Wildlife Sanctuary. We analyzed the time allotment for various activities on a daily, monthly, and seasonal basis for one group of Capped langurs. We also correlate the height on a tree at which langurs spent active time during feeding and other activities. The baseline data presented here will be useful for the strategic planning in terms of habitat evaluation and conservation of the species.

### MATERIAL AND METHODS

#### Study Area

We conducted this study at the Pakke Wildlife Sanctuary, located between 26° 55' - 27° 15' N and 92° 35' - 93° 09' E in India. This Sanctuary covers a geographical area of 861.95 sq. km in the East Kameng district of Arunachal Pradesh. The Sanctuary is surrounded by rivers on three sides and its fourth side shares a common boundary with the Nameri National Park, in the state of Assam. This area receives an average annual rainfall of 2,545 mm. The mean annual maximum temperature is 28°C and the minimum is 19°C. Average relative humidity is 84%. The altitudinal variation ranges from 100 m to 2,040 m above sea level. The Sanctuary harbours different types of vegetation namely, tropical evergreen forests, tropical semi-evergreen forests and

subtropical forests (Champion and Seth 1968). 234 woody species of flowering plants have been recorded from lowland areas of the Sanctuary. Several rare and endangered species of flora and fauna inhabit the Sanctuary. Four species of primates (*Macaca mulatta*, *M. assamensis*, *Trachypithecus pileatus* and *Nycticebus bengalensis*) are found in the Sanctuary.

**Study Group**

We identified two groups of Capped Langurs *Trachypithecus pileatus* in the study area. We chose the one male–multi-female group to collect data on the allotment of time to different activities in their natural habitat. The study ranged from October 01, 2001 to September 15, 2002. The composition of the study group was 1 adult male, 5 adult females, 1 sub-adult, and 1 infant. The group was habituated to human observers.

We adopted an *ad libitum* focal animal sampling technique as per Altmann (1974). One of the authors followed the group from 06:00 hrs to 17:00 hrs each day, for a period of 14 days per month. Thus, the hours for direct contact with langurs were 1,680. The observations were recorded into two sessions namely, forenoon (06:00-11:30 hrs) and afternoon (11:30-17:00 hrs) on different focal animal in each session (Bartlett 1999). Samples were taken at five-minute intervals. Thus, twelve entries of the focal animal were recorded in an hour. The focal animal was selected among all adult members of the group to ensure a balanced representation of each adult individual. On two occasions during study the focal animal was out of view for >15 minutes; hence we selected another focal animal of similar age to continue the observations. Animals were identified on the basis of morphology and marks on their body. We divided the observation period into three seasons: winter (November-February), summer (March-May) and monsoon (June-October).

The activities of Capped Langurs were categorized into five major classes: feeding, resting, travelling, grooming, and miscellaneous activity such as aggression and social play. Analysis of Variance (ANOVA) was used to compare daily, monthly, and seasonal variations in the time spent on different activities, and Student’s t-test for comparison of highest and lowest feeding during days and months (Simpson *et al.* 1960).

**RESULTS**

**Annual time budget and activity pattern**

The average annual time spent by a group in feeding was 36.16% (±2.45), in rest 53.41% (±7.27), in travelling 5.34% (±2.29), grooming 3.84% (±2.06), and in other activities it was 1.24% (±0.49). Resting and Feeding were

the major activities; langurs spent 90% of their active time on them. However, at 54%, resting took up more time than feeding ( $t = 3.892$ ,  $d.f. = 5$ ,  $P < 0.01$ ). The time utilized for travelling, grooming and miscellaneous activities was small.

**Monthly time budget and activity pattern**

Monthly variation in the amount of time the langurs spent on different activities (Fig. 1) was significant ( $F = 3.996$ ,  $d.f. = 11$ ,  $P < 0.001$ ). Time spent for resting was more compared to that of other activities across months. Maximum resting time (63%) was in August and minimum was (42%) in December; the variations were significant ( $t = 7.653$ ,  $d.f. = 27$ ,  $P < 0.001$ ). Time spent on feeding was maximum (42.7%) in December and minimum (32.6%) in May; the variations were found to be significant ( $t = 4.032$ ,  $d.f. = 27$ ,  $P < 0.01$ ). Langurs spent a far lower percentage of activity time travelling than feeding and resting. The travel time across months varied ( $F = 17.563$ ,  $d.f. = 11$ ,  $P < 0.001$ ), it was highest (8.3%) in February and lowest (1.87%) in August. Animals devoted very little time to grooming, but it varied significantly ( $F = 14.563$ ,  $d.f. = 11$ ,  $P < 0.001$ ) between different months. Miscellaneous activities like aggression and social play took up very little time, and monthly variations in both activities were insignificant.

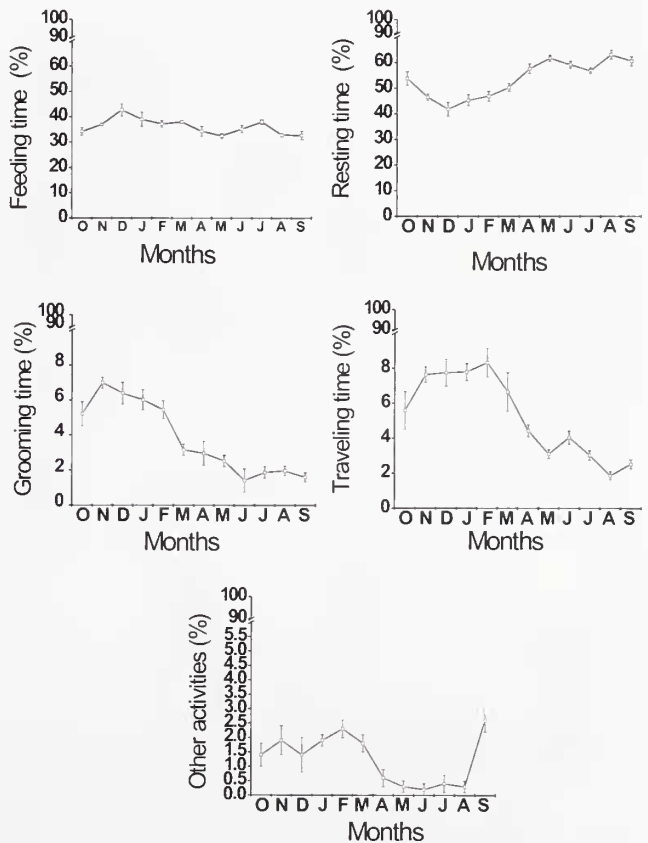


Fig. 1: Monthly variations in time (%) for different activities

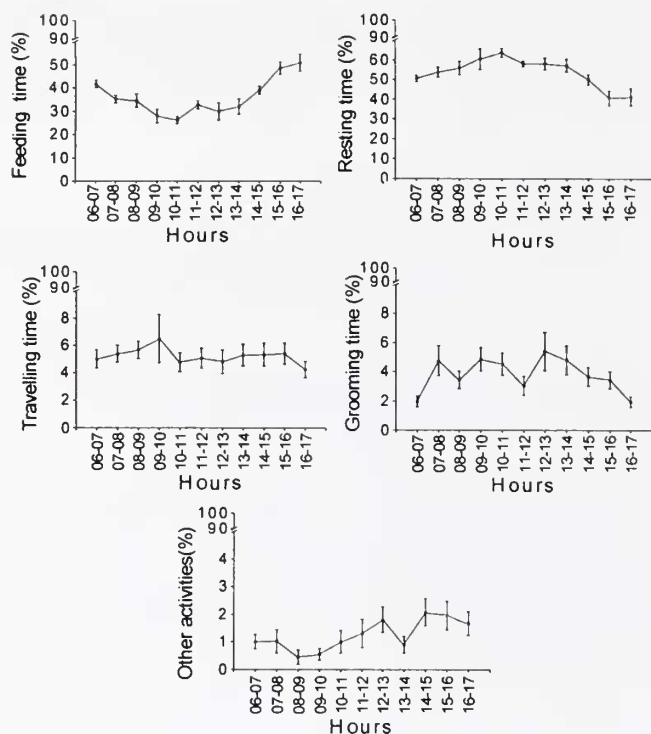


Fig. 2: Diurnal variation in time (%) for different activities

**Diurnal time budget and activity pattern**

The time allocation for activity classes during study period on an hourly basis is given in Fig. 2. Two major feeding peaks were recorded, the first occurred at early morning (06:00-07:00 hrs) and the second at evening (16:00-17:00 hrs). Time spent feeding during the evening peak was higher ( $51 \pm 13.4\%$ ) than that in morning ( $42 \pm 5.76\%$ ). These two feeding peaks were significantly distinct ( $t = 2.225, d.f. = 23, P < 0.05$ ). The morning feeding peak gradually declines and reaches its minimum between 10:00 to 11:00 hrs; thereafter, it gradually increases until the end of feeding activity of the day (Fig. 2). Langurs spent more time resting than in other activities,

including feeding; it was 64% between 10:00-11:00 hrs that gradually decreased until the end of day (Fig. 2). Time spent travelling was nearly constant across the day. The maximum travelling (6.5%) occurred between 09:00-10:00 hrs (Fig. 2). Grooming time also varied throughout the day (Fig. 2). It was highest between 12:00-13:00 hrs. Insignificant time was spent on miscellaneous activities during day too (Fig. 2). Diurnal variation in the hourly time spent on different activities was significant ( $F = 9.561, d.f. = 10, P < 0.001$ ) for feeding, resting, ( $F = 5.220, d.f. = 10, P < 0.001$ ), grooming ( $F = 2.243, d.f. = 10, P < 0.01$ ), and for miscellaneous activities ( $F = 1.878, d.f. = 10, P < 0.05$ ). Daily variations in time devoted travelling were insignificant.

**Seasonal time budget and activity pattern**

Time allotment for the different activities in different seasons is presented in Fig. 3. Feeding and resting were major activities in all three seasons and the variations between them were significant (feeding:  $F = 3.950, d.f. = 2, P < 0.05$ , resting:  $F = 14.929, d.f. = 2, P < 0.001$ , travelling:  $F = 13.464, d.f. = 2, P < 0.01$ , grooming:  $F = 13.889, d.f. = 2, P < 0.01$ ). Langur spent maximum time feeding (39%), travelling (7.88%), and grooming (6.21%) in winter. The season with the highest resting time was monsoon (58.66%).

**DISCUSSION**

In general, langurs spent by far the highest percentage of each day feeding (Kumar 2005). However, similar to many other folivorous primates (Fleagle 1988), the study animals spent more time resting than feeding or travelling. Optimal foraging theory predicts that animals should organize their feeding activities such that they can balance with energy expenditure (MacArthur and Planka 1966; Pyke *et al.* 1977). Capped Langurs rested for 54% of days surveyed (Fig.1) and leaves accounted for 68% of their annual diet (Kumar 2005; Solanki *et al.* 2008), reflect their folivore nature. Da Silva (1992, 1994) reported that folivores with diets of unusually low nutritional quality should spend more time resting than those with higher quality diets. She related the feeding time with condition of the habitat. The time spent on feeding (36%) in this study was similar to that reported for the same langur species by Gupta (1994) in Tripura, another part of north-east India, and by Stanford (1991) in Bangladesh, but the time spent on resting was higher in this study.

Biological, physical and climatic factors also influence the time budget pattern of capped langurs. The availability of dietary resources appears to influence the monkey's daily and seasonal activity budgets. In a study conducted by Solanki *et al.* (2008) it was found that 68% of the langur diet consisted of leaves and 61% of the total leaves ingested were young

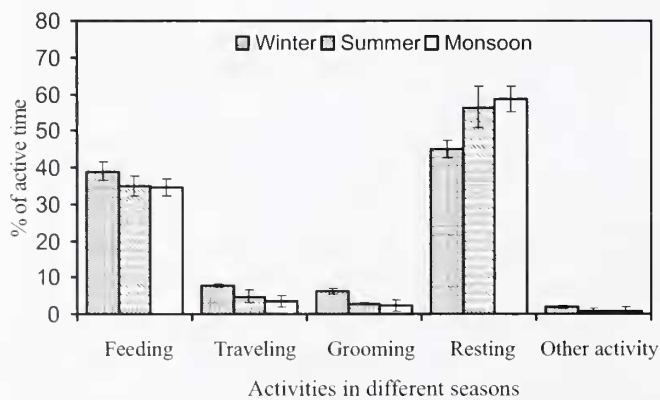


Fig. 3: Seasonal variation in time (%) for different activities

leaves. Young leaves on analysis were found to be rich in protein by Kumar and Solanki (2004); leaves and flowers were the major food items of Capped Langurs at our site (Kumar 2005; Solanki *et al.* 2008). Results of the study conducted by Gupta and Kumar (1994) on *Trachypithecus phayrei* and that of Alfred *et al.* (1998) on Capped Langur also support our results. The young leaves, the protein-rich food item in the habitat, become an important factor for budgeting feeding pattern. Vegetation in the area is predominantly evergreen to semi-evergreen type, hence young leaves remain available throughout the year in different quantities but in February, March and April young leaves come in flushes (Solanki *et al.* 2008). In our study, the group of Capped Langurs showed two feeding peaks (Fig. 2), whereas a study on *Presbytis thomasi* elsewhere showed three feeding peaks (Kunkun 1986). The less feeding, more resting and two feeding peaks reflect the good habitat condition and food resource availability.

Other than habitat condition, the animals' biological activities also affect the allotment of time. Time in winter allotted for feeding, grooming and travel was more than in monsoon. In a study conducted by Solanki *et al.* (2007), it was found that langurs exhibit two mating seasons namely, winter and summer. Winter is the longer mating season, during this period langurs undergo socialization or pairing, and mating activities; the energy demand increases, hence grooming, travel and feeding is more than in the other two seasons (Fig. 3). During monsoon, uninterrupted rains for days together reduce the availability of time for travelling, grooming and feeding; animals confined themselves to rest.

Capped langurs prefer trees of 20-25 m height for resting and sleeping at night (Choudhury 1990). Capped langurs at our study site preferred 10-15 m feeding height from forest stratum for the three major activities (feeding, resting and travelling); a preferred height of 9-11 m as reported for a Capped Langur study conducted in forests in Tripura, India (Das Gupta 2006). Vertical structure of plant community provides a physical framework for which many forms of animal life are adapted. Increase in vertical structure

means more resources and living space (Smith and Smith 2000). Terminal branches between 10-15 m height provide more food material than other regions of the tree. It was assessed by Solanki *et al.* (2008) in a study where they recorded that langur spent 44% of the feeding time in thicker terminal canopy. Studies on different species of primate in different part of the north-eastern region in India indicate that the primates prefer different activity/feeding height: Golden Langur feeds at an average tree height of 15 to 21 m (Mukherjee and Saha 1974), Pig-tailed Macaques at 8-10 m height, and Western Hoolock at 6-8 m height (Das Gupta 2006). The different feeding height in primates may be attributed to the tree size, and distribution of food items. This aspect was not studied here but needs to be addressed in detail. The available information on this aspect indicates that time budget activity is dependent on habitat condition, food availability, and feeding height on the food trees. These findings are important piece of information on the behavioural patterns of this Langur species and expand our information on its ecology. Such findings can aid in designing the management action plans for habitat and for better survival and conservation of the species.

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